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ABSTRACT

Results of the American Institute of Physics' 1984-1985 survey of physics and astronomy bachelor's degree recipients are examined. The information was obtained from individual degree recipients with a focus on their plans after the baccalaureate programs. Highlights of the findings are as follows: the proportion of women among physics bachelors further increased; almost 90% of the potential graduate physics students had been assured of their sources of support; and starting salaries reported by 1985 physics graduates rose by 6% to $1,990 per month; in 1975 fewer than one-third of new graduates chose civilian employment while by 1985 the proportion rose to 43%, and corresponding decreases occur in graduate school plans. Data are included on: characteristics of new physics bachelors and of new astronomy bachelors, postbaccalaureate plans of U.S. and foreign minorities among the 1985 physics bachelors; selected characteristics of minority physics bachelors; changes in employment for new physics bachelors, 1975-1985; and trends in plans after graduating for successive graduating classes of physics bachelors during 1975-1985 and of astronomy bachelors during 1977-1985. (SW)

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1984–85 Survey of Physics and Astronomy Bachelor's Degree Recipients

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As the class of 1985 reached a total of 5188, the number of physics bachelor's degrees granted passed the five thousand mark for the first time since 1972. Astronomy degrees at the bachelor's level amounted to 145 for the class of 1985 and reflected no major changes from the annual totals recorded in recent years. The survey upon which this report is based collects information from individual degree recipients and focuses on their postbaccalaureate plans. Comparisons are made with data from earlier years and trends are shown where possible. Highlights of the information presented in this report are:

- A further increase in the proportion of women among the physics bachelors.
- Almost 90% of the potential graduate physics students had been assured of their sources of support.
- Starting salaries reported by the class of 1985 rose by 6% to $1990 per month.

The major immediate career goals of physics bachelors fall into two categories: graduate study or employment, and the class of 1985 shows a continuing shift toward employment. Both **Figure I** and **Table I** show the postbaccalaureate plans of physics bachelors for the past ten years and how gradual the changes were during that period. For example, a decade ago fewer than one-third of the new graduates chose civilian employment; by 1985 that proportion had risen to 43%. Corresponding decreases can be observed in graduate school plans, particularly among those who changed to another subject of study. The bottom row of **Table I** lists the total number of physics bachelor's degrees granted each year; these data are derived from the departmental survey of Enrollments and Degrees.

Figure I. Trend in postbaccalaureate plans of physics bachelors, 1976–1985.

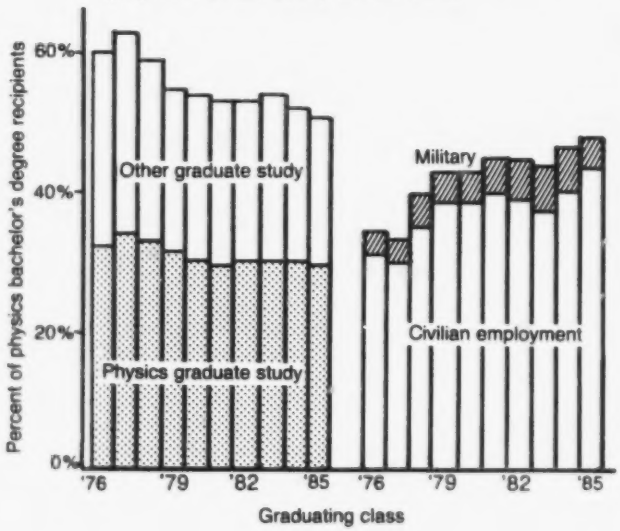


Table I. Postbaccalaureate plans of successive graduating classes of physics bachelors, 1975–1985.

Postbaccalaureate plans	1975–76	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84	1984–85
Physics graduate study	32%	34%	33%	31%	30%	29%	30%	30%	30%	29%
Other graduate study	28	28	26	24	24	24	23	24	22	21
Civilian employment	31	30	34	38	38	39	38	36	40	43
Military service	4	4	5	5	5	6	7	8	6	5
Undecided	5	4	2	2	3	2	2	2	2	2
Total number of physics bachelor's degrees	4487	4517	4457	4416	4440	4513	4558	4795	4878	5188

Table II. Characteristics of new physics bachelors, 1984–85.

Characteristics		Postbaccalaureate plans: Graduate study Physics	Graduate study Other	Employment	Undecided	Total
Sex	Female*	14%	16%	14%	11%	14.4%
	Male	86	84	86	89	85.6
Citizenship	U.S.	92%	90%	97%	88%	94.0%
	Foreign	8	10	3	12	6.0
Age	20 or younger	1%	1%	–	–	0.6%
	21	6	5	2%	–	3.9
	22	48	50	38	28%	43.3
	23	23	24	26	40	24.6
	24–27	15	14	23	23	19.0
	28 or older	7	6	11	9	8.6
Minority groups	U.S. blacks	1.1%	2.0%	1.8%	2.3%	1.7%
	Other U.S. minor.	4.9	4.8	4.4	2.3	4.6
	Foreign minorities	3.5	5.0	1.7	7.0	3.0
Double major	Yes	26%	35%	25%	20%	27.3%
	No	74	65	75	80	72.7
Type of undergraduate institution	Public	54%	45%	60%	53%	58.0%
	Private	46	55	40	47	42.0
	PhD-granting	60%	46%	45%	40%	49.4%
	MS-granting	11	8	12	14	12.7
	BS/BA-granting	29	46	43	46	37.9
Total number of bachelors		1484	1110	2501	93	5188
% distribution		29%	21%	48%	2%	100%
Number of respondents		718	538	1210	44	2510

**Percentage of women was adjusted for differential response rate.*

As the number of physics bachelors increases from year to year we try to monitor possible changes in their characteristics. The six characteristics presented in **Table II** are shown not only for all respondents of the class of 1985 combined, but also for major subgroups. For example, physics students at the undergraduate level include 6% foreign students; however, those who were employment-oriented included only 3% foreign students, whereas 8–10% of the potential graduate students are foreign citizens. Comparable differences in characteristics for subgroups exist when we examine the graduates' ages or the types of undergraduate institutions physics students chose. For example, bachelors who were accepted for full-time graduate study tend to be younger than their employment-oriented counterparts. Also, less than one-third (29%) of the potential graduate physics students attended 4-year colleges, but almost half (43%) of the employment-oriented graduates were enrolled at that type of institution. Dividing the institutions into public and private schools adds a new characteristic to the list presented in **Table II**.

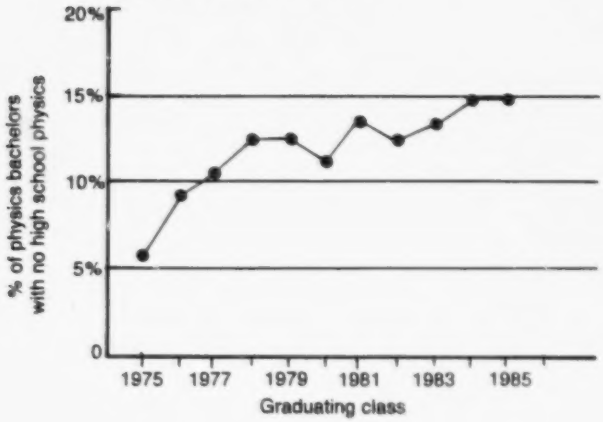
The teaching of high school physics is the responsibility of local governments; consequently there are many school districts that either do not offer physics at all, or do not offer it every year. To see what effect this situation had on those who completed physics bachelor's degrees, we asked what type of high school physics course, if any, the graduates had taken. Over two thousand responses to that question are presented in **Table III**. Among other things it indicates that women are less likely to have enrolled in PSSC courses and more likely not to have taken physics at all. For all physics bachelors combined the percentage who did not take high school physics was 17. Focusing on the "potential physicists," namely the subgroup of bachelors whose post-degree

Table III. A comparison between men and women 1984–85 physics bachelors and their high school physics backgrounds.

Type of high school physics		Women	Men	Total %	Total N
PSSC*		18%	24%	23%	477
Project physics		11	13	13	264
Other		48	47	47	950
None		23	16	17	351
Total respondents	%	100%	100%	100%	
	N**	305	1737		2042

**PSSC = Physical Science Study Committee*
***Nonrespondents to the question = 468*

Figure II. Physics bachelors, entering graduate physics departments, who did not take high school physics, 1975 to 1985.



plan is graduate study in physics, we find that as many as 15% of them had not taken physics in high school. **Figure II** shows that during the past decade this percentage has increased rather rapidly because in 1975 only 6% of a comparable subgroup of physics bachelors fell into that category.

Having demonstrated in connection with **Table II** how the characteristics of a composite group can differ significantly from those of its component parts we apply a similar analysis in **Table IV** to the minority students among the physics bachelors. The postbaccalaureate plans of U.S. minority students as a whole are similar to those of all respondents from the class of 1985. However, by examining the plans of U.S. blacks and U.S. Orientals separately, we find that an above-average proportion of blacks seeks immediate employment whereas above-average proportions of the Orientals enter graduate schools.

Different considerations should be applied to foreign minority students, who, like most foreign students, are in the U.S. on student visas that do not make them eligible for employment. Thus we find that a large proportion of the foreign minorities (72%) plan to enter graduate school.

Additional details on minorities are provided in **Table V** which lists six distinct minority groups and the numbers of physics bachelors who identified themselves with each group. The larger groups that are neither predominantly foreign nor predominantly U.S. are divided on the basis of citizenship and the following three characteristics are presented: sex, region and type of bachelor's institution. Thus the table indicates that U.S. blacks include a very high proportion of women and that they are concentrated in the four-year colleges. U.S. Orientals, on the other hand, tend to choose PhD-granting institutions for their undergraduate studies.

Table IV. Postbaccalaureate plans of U.S. and foreign minorities among the physics bachelors of the class of 1985.

	Postbaccalaureate plans				
	Graduate study			Total	
Minorities	Physics	Other	Empl.	%	N
U.S. blacks	19%	26%	55%	100%	42
U.S. Orientals	36	24	40	100	62
Other U.S. minorities	25	21	54	100	53
Total U.S. minorities	27%	24%	49%	100%	157
Foreign Orientals	41%	31%	28%	100%	32
Other foreign minorities	34	39	27	100	44
Total foreign minorities	37%	35%	28%	100%	76
All respondents	29%	21%	50%	100%	2510

Table V. Selected characteristics of minority physics bachelors, 1985.

		Minority group								
		Black		Amer.	Hispanic		Oriental		Asian	
		U.S.	Foreign	Indian	U.S.	Foreign	U.S.	Foreign	Indian	Arab
	Total	42	10	6	29	5	62	32	15	29
Sex	Female	10	1	2	3	1	14	5	2	6
	Male	32	9	4	26	4	48	27	13	23
*Region of bach's inst.	Northeast	7	6	1	8	2	22	9	5	6
	Southeast	25	–	2	3	1	2	2	3	3
	Central & Mountain	10	3	2	7	2	10	11	6	9
	Pacific	–	1	1	11	–	28	10	1	11
Type of bach's inst.	PhD-granting	5	2	3	18	4	46	16	4	14
	MS-granting	10	1	2	5	1	1	4	2	6
	BS/BA-granting	27	7	1	6	–	15	12	9	9

**Regions: Northeast = New England, Middle Atlantic; Southeast = South Atlantic, East South Central; Central = East North Central, West North Central, West South Central.*

Table VI. Sources of anticipated support for first-year graduate study*, 1979–85.

Sources of support	Students planning: Physics graduate study 1979	1982	1985	Other graduate study 1979	1982	1985
Teaching assistantship	66%	64%	67%	24%	26%	25%
Research assistantship	15	15	10	24	20	18
Fellowship	12	12	12	15	15	14
Employment (part-time)	2	3	3	11	13	16
Family, savings, loan	3	4	7	20	23	23
Other	2	2	1	6	3	4
	100%	100%	100%	100%	100%	100%
Graduate study status: full-time	93%	94%	91%	92%	88%	75%
Graduate study status: part-time	7	6	9	8	12	25
Total number of full-time students	1372	1355	1484	1083	1066	1110

**The information was reported for September of each academic year.*

The decision of which graduate school to choose is frequently based on the type of support being offered. The most common type of support accepted by two-thirds of the first-year graduate physics students is a teaching assistantship. Research assistantships and fellowships combined, are offered to approximately one-quarter of the first-year physics students, leaving only a small proportion of students each year who need to use personal funds or have to resort to part-time off-campus employment. **Table VI** presents these data for selected years since the late 1970's and compares the first-year physics students with those who were interested in other disciplines of graduate study. Members of the nonphysics group are much less likely to be offered teaching assistantships and more likely to support their graduate study by means of family funds, loans or part-time employment. Between 30% and 40% of them reported these sources of support compared to at most 10% of the entering graduate physics students.

The lower portion of **Table VI** is based on a slightly larger group of new physics bachelors because it includes those who have accepted full-time employment and pursue graduate study on a part-time basis. In physics the part-time students comprise between 6% and 9%, whereas those who entered "other graduate study" included a portion that increased from 8% to 25% in a six-year period.

Because a large proportion of the physics bachelors each year are interested in immediate employment, the demand for them is a piece of information to monitor annually. To accomplish that we ask each employment-oriented bachelor for the number of job offers he or she received, which provides us with a scale of no offers, one offer and multiple offers. **Table VII** presents these data consecutively since 1980 in addition to 1975 and 1977 for comparison purposes. It should be pointed out that "zero job offers" refers to the time immediately following graduation and should not be mistaken for a general unemployment rate. Thus an overall evaluation of the demand for physics bachelors is that close to 90% of the employment-oriented graduates accept positions shortly after graduation, although the proportion of graduates that reported multiple offers has definitely declined since the late 1970's.

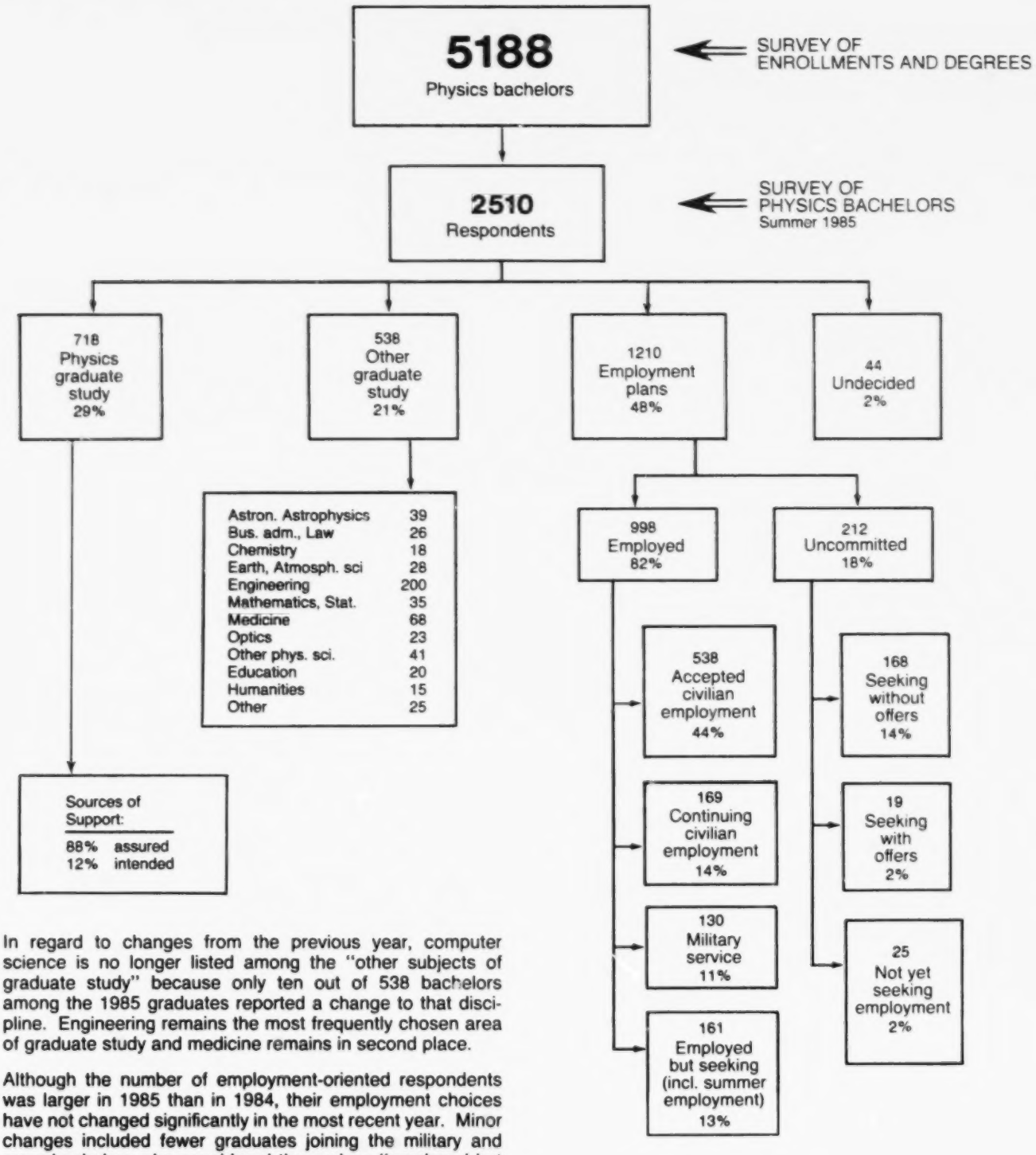
Despite the frequent use of the term "plans" in this report, a large proportion of the graduates have made firm commitments to different postbaccalaureate activities. **Figure III** offers unique details of the plans that have already materialized as well as those that are still pending by the end of the summer of 1985. The flow diagram lists the major subjects of graduate study for those physics bachelors who chose a physics-related or another discipline for their graduate work. Furthermore, **Figure III** divides the employment-oriented graduates into categories which specify different stages of entry into the labor force.

Table VII. Changes in employment outlook for new physics bachelors, 1975–1985.

Number of job offers at graduation	Summer 1975	Summer 1977	Summer 1980	Summer 1981	Summer 1982	Summer 1983	Summer 1984	Summer 1985
0	17%	11%	10%	10%	13%	11%	13%	14%
1*	56	52	50	55	57	58	54	59
2 or more	27	37	40	35	30	31	33	27

**Bachelors who enter the military service are included here.*

Figure III. Postbaccalaureate plans of physics bachelors of the class of 1985.



In regard to changes from the previous year, computer science is no longer listed among the "other subjects of graduate study" because only ten out of 538 bachelors among the 1985 graduates reported a change to that discipline. Engineering remains the most frequently chosen area of graduate study and medicine remains in second place.

Although the number of employment-oriented respondents was larger in 1985 than in 1984, their employment choices have not changed significantly in the most recent year. Minor changes included fewer graduates joining the military and more bachelors who considered themselves "employed but seeking" which refers to seeking more appropriate positions than the ones they had accepted.

Table VIII. Initial employment of physics bachelors, 1975–85.

Type of employer	Percentage of employed bachelors									
	1975–76	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84	1984–85
Industry {manufacture	30%	32%	37%	40%	41%	40%	38%	33%	38%	35%
Industry {service	19	16	21	18	20	22	22	20	16	20
High school	11	8	7	6	3	2	3	4	4	4
College or university	4	5	3	4	3	4	4	4	5	3
Government {civilian	10	7	7	7	8	7	7	10	12	14
Government {military	13	12	14	15	16	21	24	27	24	23
Other	13	20	11	10	9	4	2	2	1	1
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

By terminating the study of physics at the bachelor's level, graduates are well qualified to teach high school physics or work as technical assistants or junior engineers in industry. **Table VIII** compares the distributions of initial employers reported by successive classes of physics bachelors over a ten-year period and shows that a majority of graduates each year accept positions in industry. High schools have attracted only a very small percentage of graduates in recent years because of the comparatively low salaries offered. Since the beginning of the 1980's close to one quarter of the employment oriented graduates joined the military because it combines work experience with further training.

The median starting salary offered by all employers combined reflects a 6% increase over that offered in the previous year, and the range of median salaries shown in **Table IX** extends from $1260 to $2250. The highest salaries are generally associated with manufacturing industries, which are also regarded as making extensive use of the new employee's training. Initial employment in a service industry is also linked to a relatively high salary, but it is the college degree to which importance is attributed rather than the specific physics training.

Table IX is clear in suggesting why only 4% of the new graduates enter high school teaching; the monthly salaries teachers are paid are 36% below the overall median starting salary and significantly below those offered by manufacturing industries.

It has been true since the late 1970's that the overall median salary for women bachelors is higher than that for men because a much larger number of men join the military where salaries are 25% below the median. On the other hand, **Table IX** indicates that employers in most areas now offer higher salaries to women than to men, and that has not been true in recent years.

The employment-oriented graduates of **Figure III** include 169 bachelors who had decided to remain with employers for whom they worked before receiving their bachelor's degrees. This group had been excluded from **Tables VIII** and **IX** because these degree recipients did not seek employment in 1985 and their salaries were generally higher. However, **Table X** includes the group described as "continuing civilian employment" because its members also hold full-time potentially permanent positions whose work activities and employers are of interest. Since industry employs a majority of the bachelors, research, development and design are the most frequently reported work activities. In fact, the group engaged in development and design indicated a seven percentage-point increase over the previous year. Since the ability to program is often a skill acquired as part of the physics bachelor's degree, 16% of the respondents listed programming as their primary work activity. "Other professional work" increased by three percentage-points over the previous year and includes graduates who are self-employed.

Table IX. Starting salaries of physics bachelors, 1985.

Type of employer	Men (465 reported salaries)		Women (80 reported salaries)		Total (545 reported salaries)	
	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary
Industry {manufacture	35%	$2250	36%	$2200	35%	$2250
Industry {service	19	2080	23	2200	20	2080
High school	4	1260	8	1330	4	1270
College or university	3	1420	3	**	3	1420
Government {civilian	10	1590	12	1790	11	1660
Government {military	25	1500	13	1560	23	1500
Fed. Fund.Res. Ctr.	3	2200	5	2240	3	2200
Other	1	1500	–	**	1	1610
Total	100%	$1960	100%	$2000	100%	$1990

***Insufficient data.*

Table X. Full-time employment* of new physics bachelors, 1985.

Work activity	Type of employer: Industry manufacture	Industry service	High school	Government civilian	Government military	Coll./ univ.	Total N	Total %
Teaching	1	1	30	5	1	2	40	6%
Res. & dev.	85	25	–	31	18	10	169	25
Dev. & design	97	41	–	21	5	2	166	24
Programming	30	43	–	19	10	4	106	16
Skilled work	21	13	–	6	6	7	53	8
Specialized training**	10	11	–	6	78	–	105	15
Other prof. work	13	17	–	5	7	1	43	6
Total N	257	151	30	93	125	26	682	
Total %	38	22	4	14	18	4		100%

The employment of these 682 graduates includes both newly accepted positions as well as those in which graduates are continuing. Excluded are graduates in temporary and summer employment.

***Training paid for by the employer which includes pilot navigator training by the military.*

ASTRONOMY

There were 145 astronomy bachelor's degrees granted in 1984–85 primarily by doctorate-granting institutions and a majority of them began full-time graduate study immediately. Approximately half the graduates responded individually to our survey of astronomy bachelors, and **Table XI** summarizes their characteristics by postbaccalaureate plan. Thus we find that astronomy bachelors include a higher proportion of women, fewer foreign students and tend to be younger than their physics counterparts. Since the number of astronomy respondents was 72, only the "total" column in **Table XI** was converted to percentages, but the overall format of the table is similar to **Table II**.

Table XI. Characteristics of astronomy bachelors, 1985.

Characteristics		Postbaccalaureate plans: Graduate study Astronomy N	Other N	Employment N	Undecided N	Total %
Sex	Female	4	2	5	1	17%
	Male	21	11	27	1	83
Citizenship	U.S.	25	13	32	2	100%
	Foreign	–	–	–	–	–
Type of high school physics**	*PSSC	5	1	6	–	21%
	Project physics	3	1	5	–	16
	Other	10	6	15	2	58
	None	1	–	2	–	5
Age	21 or younger	5	1	–	1	10%
	22 yrs.	13	7	16	1	52
	23 yrs.	5	4	8	–	23
	24 or older	2	1	8	–	15
Type of bachelor's institution	PhD-granting	17	9	20	1	65%
	MS-granting	4	1	2	–	10
	BS/BA-granting	4	3	10	1	25
Type of degree	Science	11	5	22	1	54%
	Arts	14	8	10	1	46
Double major	Yes	10	8	8	–	37%
	No	15	4	23	2	63
Total respondents		25	13	32	2	72

*PSSC = Physical Science Study Committee.

**There were 15 nonrespondents to this question.

Table XII. Postbaccalaureate plans of successive graduating classes of astronomy bachelors, 1977–85.

Postbaccalaureate plans	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84	1984–85
Astronomy graduate study	33%	28%	35%	24%	29%	38%	38%	35%
Other graduate study	22	19	17	13	25	17	31	18
Employment	40	51	43	59	45	41	28	44
Undecided	5	2	5	4	1	4	3	3
Total number of astronomy bachelors	177	165	165	156	181	138	137	145

The trend data shown in **Table XII** combine information derived from two surveys: the total number of astronomy degrees granted were reported by astronomy departments, while the postbaccalaureate plans come from the survey of individual graduates. The fluctuations in this trend must be attributed to the small number of respondents per year.

Figure IV offers additional details on the 72 astronomy bachelors and their postbaccalaureate plans. For example, the distribution of sources of support for graduate astronomy students differs from that for graduate physics students by having the teaching assistantships equal to the fellowships; for physics students their ratio is 7:1. Very few, if any astronomy bachelors change to graduate study in engineering, and the employment-oriented graduates, like those in physics, find positions in industry.

Figure IV. Postbaccalaureate plans of astronomy bachelors of the class of 1985.